Earthwork Inspectors Training

NYSDOT

Geotechnical Engineering Bureau

Student Handout

Schedule

- Session 1: Section 203: Excavation & Embankment
- Session 2: Soil Description
  - Creating a "Word Picture"
- Session 3: Soil Gradation
  - Importance in Highway Construction
  - Test Procedure and Lab Exercise

Day 1 AM

- Session 4: Moisture-Density Relationship of Soil
  - Concept & Principles
  - Test Procedure & Lab Exercise
  - Family of Curves

Day 1 PM

- Session 5: Field Density Determination
  - Importance in Highway Construction
  - Test Procedure and Lab Exercise

Day 2 AM

- Review
- Test

Day 2 PM

FACTORS INFLUENCING EMBANKMENT CONSTRUCTION

1. EMBANKMENT MATERIALS

A. Suitable
1. Mineral (inorganic) Soil
2. Blasted or broken rock
3. Similar materials of natural man-made origion
4. Mixtures of the above

B. Unsuitable
1. Muck, Peat, Organic Silt
2. Topsoil, Sod
3. Certain man-made deposits of industrial waste, sludge or landfill

C. Unstable
A suitable material whose moisture content causes it to become unstable under load

2. MOISTURE CONTENT

A. Moisture is needed to lubricate soil particles so they move close together for maximum density when compacted.

B. Too much Moisture results in excess pore pressure and maximum density cannot be obtained. (Unstable Material).

C. The contractor is responsible for determining the proper moisture content at which to compact material.

3. LIFT THICKNESS

A. Soil & Rock - Controlled by compaction equipment (Section 203-3.12)

B. Importance of layer thickness
1. Compaction effectiveness decreases rapidly with depth.
2. Thin layers provide maximum uniformity when compacted properly

C. Exceptions - For an unstable foundation soil - Begin embankment with up to a 3 foot lift of material

D. Maximum Particle Size
1. Embankment: 2/3 loose lift thickness
2. Subgrade: 6 inches

4. EQUIPMENT

ROLLER TYPE	MOST EFFECTIVE USE	REMARKS	SPECIFICATION REQUIREMENTS
RUBBER-TIRED (PNEUMATIC)	SAND & GRAVEL SUBBASE STABILIZED MATERIAL	VERSATILE MACHINE PROVIDES A KNEADING ACTION THAT GIVES GOOD COMPACTION	FIGURE 203-1 AND FIGURE 203-2 IN STANDARD SPECIFICATIONS
SMOOTH DRUM	GRANULAR MATERIAL ROCK BASE COURSE SEAL ROLLING	A MUST FOR SEAL ROLLING, PRODUCING A SMOOTH UNIFORM SURFACE	
SMOOTH DRUM VIBRATORY	GRANULAR MATERIAL ROCK	VIBRATING LOADS PROVIDE BETTER RESULTS THAN STATIC LOADS	FIGURE 203-3 IN STANDARD SPECIFICATIONS
SHEEPSFOOT	SILTS AND CLAYS SILTS	NOT RECOMMENDED FOR STONY SOILS	
SEGMENTED	SILTS AND CLAYS	ACTION IS SIMILAR TO SHEEPSFOOT	
PROOF ROLLER	REQUIRED ON ALL SUBGRADES	USED TO VERIFY UNIFORMITY	FIGURE 203-4 SECTION 203-3.13* SECTION 203.3.14**
UNCLASSIFIED COMPACTION EQUIPMENT		EVALUATE BASED ON SITE FIELD TESTS CONDUCTED BY ENGINEER	
EARTHMOVERS OR TRUCKS		DO NOT SUBSTITUTE FOR COMPACTION EQUIPMENT!!!	

* CONTRACTOR IS RESPONSIBLE FOR NECESSARY CORRECTIVE TREATMENTS OF EMBANKMENTS

** STATE IS RESPONSIBLE FOR ANY NECESSARY CORRECTIVE TREATMENTS OF CUT SECTIONS

5. TESTING FREQUENCY (CONSTRUCTION SUPERVISION MANUAL)

ITEM	COMPACTION	GRADATION
Embankment Construction Material	One test for each Day, Fill or 10,000 cubic yards*	Not Required
Select Granular Items	One test for each Day, Fill or 10,000 cubic yards*	One test for each Day, Source or 5,000 cubic yards*
Granular Pipe Backfill Items	One test for each Day, Structure or 500 cubic yards*	One test for each Day, Source or 500 cubic yards*
Slope Protection Material	Not Required	One test for each Day, Source or 5,000 cubic yards*
Underdrain Filter Material	Not Required	See Geotechnical Control Procedure
Structure Backfill	One test for each Day, Structure or 500 cubic yards*	One test for each Day, Source or 1,000 cubic yards*
Subbase Course (Non-Stockpiled)	Not Required	Two tests for each Day, source 1,500 cubic yards or as shown in the appropriate Geotechnical Control Procedure*
Subbase Course (Stockpiled)	Not Required	See Geotechnical Control Procedure
Trench & culvert and Structure Excavation Backfill	One test for each Day, Structure or 500 cubic yards*	Not Required

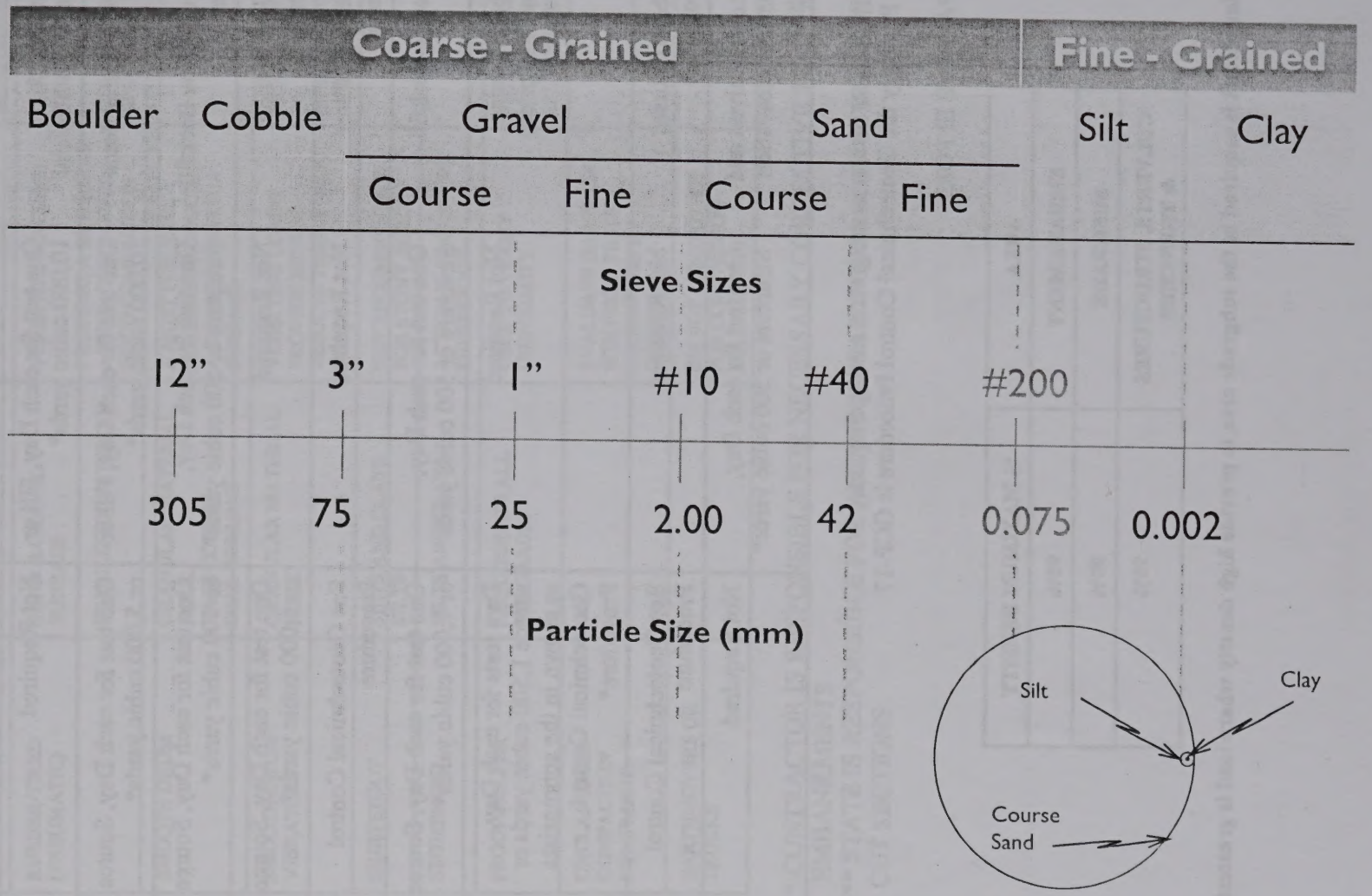
* Whichever results in the greater testing frequency
Presently the Geotechnical Control Procedure is GCP-17

6. COMPACTIVE EFFORT

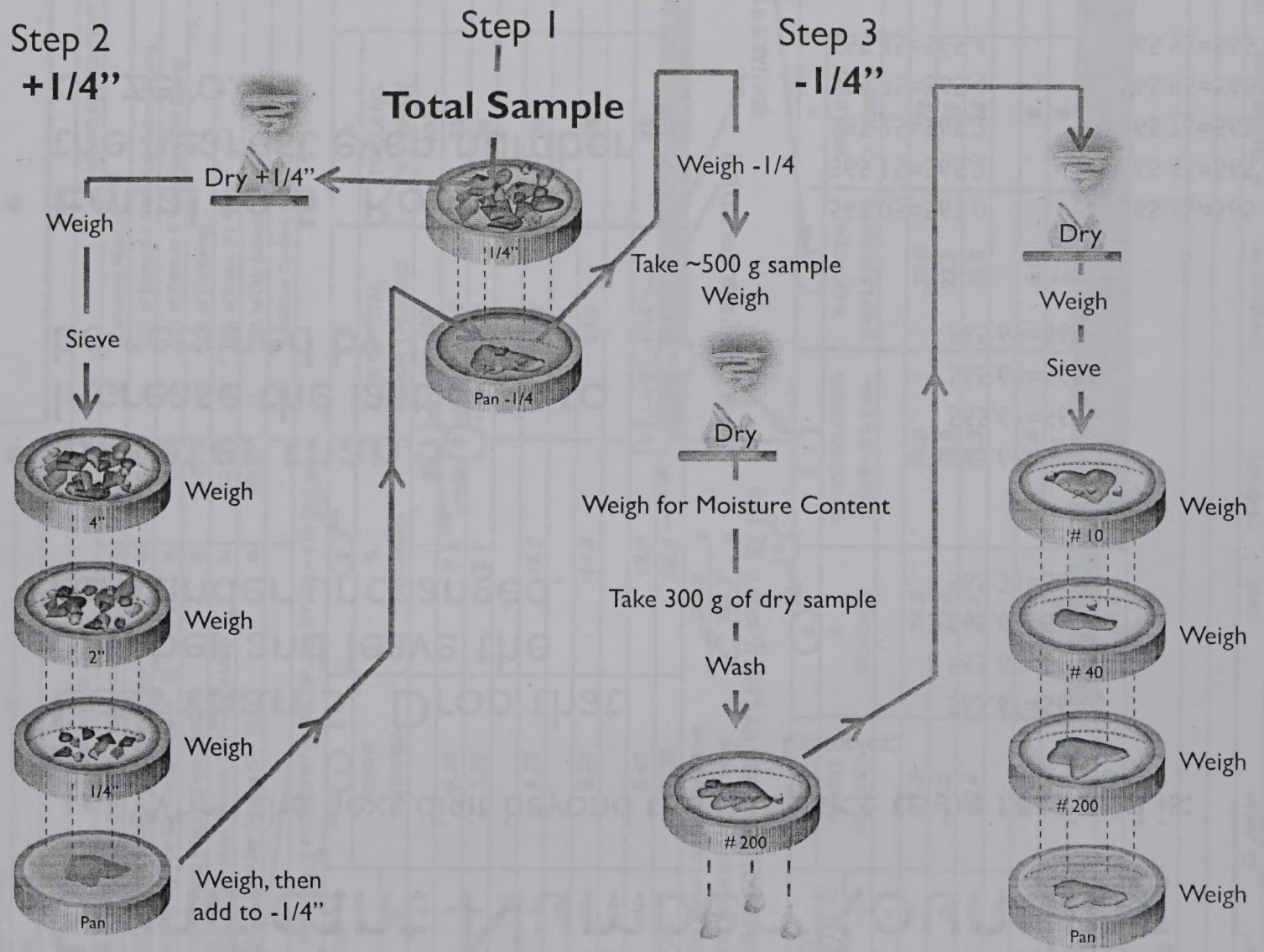
AREA	% MAXIMUM DENSITY
EMBANKMENT	90%
SUBGRADE	95%
CULVERTS, STRUCTURES & TRENCHES	95%

More effort is required in the subgrade area to provide high density where load is greatest.

Particle Size Chart



Gradation Test Procedure



Significant Number Rounding

- When the next digit beyond the last place to be retained is:

- **Less than 5**. Drop that number and leave the remainder unchanged.
  - Examples:
    - 565.61=565.6
    - 565.62=565.6
    - 565.63=565.6
    - 565.34=565.6

- **Greater than 5**. Increase the last digit to be retained by 1.
  - 565.66=565.7
  - 565.67=565.7
  - 565.68=565.7
  - 565.69=565.7

- **Equal to 5**. Round to the nearest even number or zero.
  - 565.05=565.0
  - 565.15=565.2
  - 565.25=565.2
  - 565.35=565.4
  - 565.45=565.4
  - 565.55=565.6
  - 565.65=565.6
  - 565.75=565.8
  - 565.85=565.8
  - 565.95=566.0

SM 15b (8/94) CLASSROOM CHEATSHEET

GEOTECHNICAL ENGINEERING BUREAU

SIEVE ANALYSIS DATA

Project *Earthwork Inspectors School*
PIN *1234.56.789* Contract No. *D123456*
Region *1-11* County *AnyCounty*
Material Source *Generic Sand & Gravel*
Location Sta. *100+00* Offset *CL* Depth *Surface*
Item No. *304.14M*
Sample No. *1*

PROJECT STAMP

LINE	SAMPLE WEIGHTS		
A	Wt. of Dry Plus 6.3 mm After Separation	lb.	*31.38*
B	Wt. of "Pan" Material from Plus 6.3 mm	lb.	*0.80*
C	Wt. of Dry Plus 6.3 mm Material (A - B)	lb.	*30.58*
D	Wt. of Moist Minus 6.3 mm Material	lb.	*24.09*
E	Wt. of Dry Minus 6.3 mm D÷(1+(MC÷100))	lb.	*23.39*
F	Wt. of Total Dry Sample (C + E)	lb.	*53.97*

LINE	MOISTURE CONTENT		
G	Container Number		*A*
H	Wt. of Sample & Container Before Drying	g	*581.2*
I	Wt. of Sample & Container After Drying	g	*566.3*
J	Wt. of Container	g	*67.1*
K	Wt. of Water (H - I)	g	*14.9*
L	Wt. of Dry Sample (I - J)	g	*499.2*
M	Moisture Content (K / L) x 100%		*3.0*

(# IN *COL. 1* DIVIDED BY *F*, MULTIPLIED BY 100 = # IN *COL. 2*)

SIEVE		(1)	(2)	3	4	
mm	in.	WEIGHT RETAINED	% RETAINED	% OF TOTAL SAMPLE PASSING	WHOLE NO. % PASSING	SPECIFICATION REQUIREMENT
100	4			*100*	*100*	
75	3	*4.20*	*7.8*	*92.2*	*92*	
50	2	*3.10*	*5.7*	*86.5*	*86*	*100*
37.5	1 1/2					
25.0	1	*8.72*	*16.2*	*70.3*	*70*	
19.0	3/4					
12.5	1/2	*8.03*	*14.9*	*55.4*	*55*	
9.5	3/8					
6.3	1/4	*6.48*	*12.0*	*43.4*	*43*	*30 -65*
TOTAL		*30.53*	*56.6*			

N. Wt. of Dry Minus 6.3 mm Before Wash *301.8* g
O. Wt. of Dry Minus 6.3 mm After Wash *280.7* g

(# IN *COL. 5* DIVIDED BY *LINE N*, MULT. BY 100)

(# IN *COL. 7* MULTIPLIED BY)

(EQUALS # IN *COL. 8*)

SIEVE DESIGNATION		(5)	(6)	(7)	(8)	9	
mm	No.	WEIGHT RETAINED	% RETAINED	% PASSING BASED ON MINUS 6.3 mm	% OF TOTAL SAMPLE PASSING	WHOLE NO. % PASSING	SPECIFICATION REQUIREMENT
4.75	4						
2.00	10	*73.2*	*24.2*	*75.8*	*32.9*	*33*	
0.850	20	*71.8*	*23.8*	*52.0*	*22.6*	*23*	
0.425	40	*62.4*	*20.7*	*31.3*	*13.6*	*14*	*5 - 40%*
0.250	60						
0.150	100	*59.8*	*19.8*	*11.5*	*5.0*	*5*	
0.075	200	*13.3*	*4.4*	*7.1*	*3.1*	*3*	*0 - 10%*
PAN		*0.7*					
TOTAL		*281.2*	*92.9*				

REMARKS

TESTED BY: *D. Jeter* DATE *01/01/01* CHECKED BY: *N. Garciaparra* DATE *01/01/01*

GRAIN SIZE ANALYSIS

1. **DON'T** overload sieves. Overloading causes the sieves to become clogged and results in poor and inadequate separation.

2. **DON'T** allow water to overflow or splash out of the No. 200 sieve during the washing operation. This causes a loss of fines.

3. **DON'T** exert too much pressure on the No. 200 sieve during the wash test. Too much pressure will stretch the screen, changing the opening size. Also, small punctures or tearing of the screen may occur.

4. **DON'T** wash sample on No. 200 improperly or insufficiently. Improper washing will cause errors in the final computations.

5. **DON'T** perform a wash test without using a wash basin under the No. 200 sieve. In case of spillage, the sample can be recovered. The basin also serves to help determine when the wash is completed, by the color of the water.

6. **DON'T** leave weights and miscellaneous material on scales.

DO

1. Obtain a representative sample of the granular material to be tested. The size of the sample shall depend on its top size. The larger the top size of the particles, the greater amount of material needed. (Refer to STM-20.)

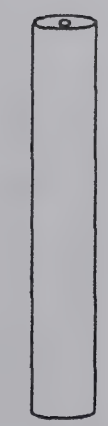
2. Check all sieves for excessive wear, holes and rips. If any of these are found, the sieve should be replaced immediately.

3. Level and zero scales before using: keep them clean! Check before using for accuracy, binding, etc.

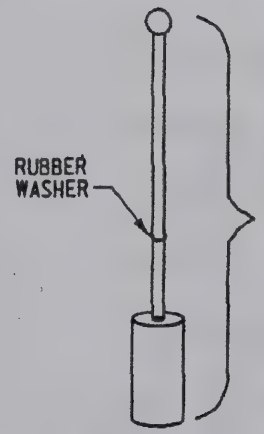
4. Place a thin layer of sand between the stove or hotplate surface and the pan containing the sample. This will prevent splattering and/or burning of the sample during drying operations.

5. Wash the minus $^1/_4$ inch sample thoroughly to remove all particles that could have a tendency to cling to the plus No. 200 fractions.

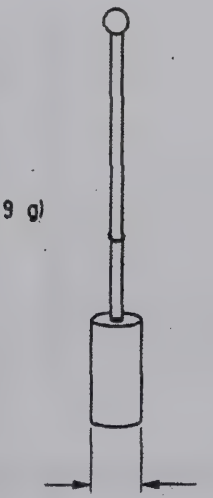
STANDARD COMPACTION HAMMER DIMENSIONS, WEIGHT AND TOLERANCES

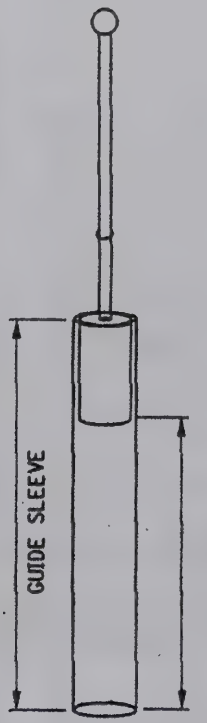


HAMMER GUIDE SLEEVE

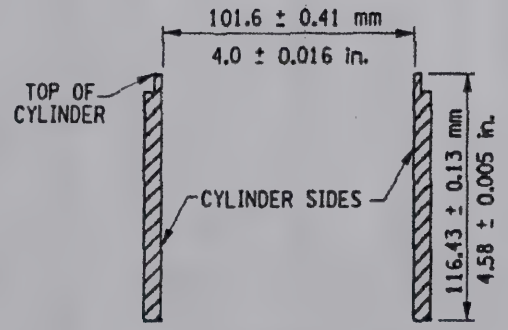


HAMMER

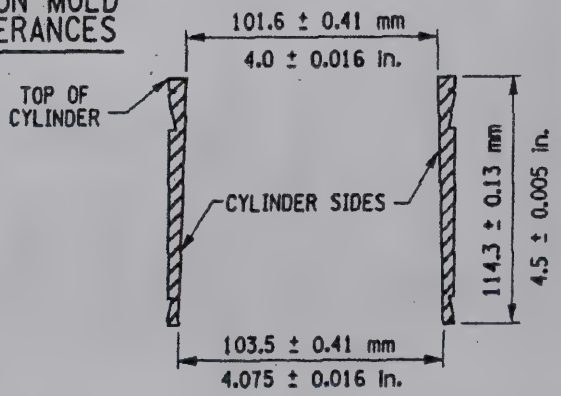




PROCTOR COMPACTION MOLD DIMENSIONS & TOLERANCES



X-SECTION STRAIGHT SIDED



X-SECTION TAPERED

GEOTEC98 M01909.GEB

Wet Density

$$\frac{\text{Weight of Wet Soil}}{\text{Volume of Mold (or Hole)}} = \text{Wet Density}$$

Dry Density

$$\frac{\text{Wet Density}}{1 + \text{Moisture Content (decimal form)}} = \text{Dry Density}$$

Moisture Content

$$\frac{\text{Weight of Water}}{\text{Weight of Dry Soil}} \times 100 = \%\ \text{Moisture}$$

Proctor Compaction		
	Standard Effort	Modified Effort
Max. Particle Size	¾"	¾"
Mold Volume	1/30 ft^3	1/30 ft^3
Hammer Weight	5.5 lbs	10 lbs
Drop Height	12"	18"
Number of Layers	3	5
Blows per Layer	25	25

EXAMPLE: COMPUTATIONS FOR PROCTOR COMPACTION

GIVEN:	*FIND:*
WEIGHT OF CYLINDER & WET SOIL = **12.70 lb.**	WEIGHT OF WET SOIL
WEIGHT OF CYLINDER = **9.12 lb.**	WET DENSITY OF SOIL
WEIGHT OF DRY SOIL (from moisture content test) = **481.2 g**	MOISTURE CONTENT
WEIGHT OF WATER (from moisture content test) = **39.4 g**	DRY DENSITY OF SOIL
VOLUME OF CYLINDER = **1/30 cubic foot**	

STEP 1: DETERMINE WEIGHT OF WET SOIL

WET SOIL = WEIGHT OF CYLINDER & SOIL - WEIGHT OF CYLINDER

= 12.70 lb. - 9.12 lb.

= 3.58 lb.

STEP 2: DETERMINE THE WET DENSITY OF THE SOIL

WET DENSITY = WEIGHT OF WET SOIL ÷ VOLUME OF CYLINDER

= 3.58 lb. ÷ (1/30 c.f.)

= 3.58 lb. x 30

= 107.4 lb./ c.f.

STEP 3: DETERMINE THE MOISTURE CONTENT OF THE SOIL

MOISTURE CONTENT = (WEIGHT OF WATER ÷ WEIGHT OF DRY SOIL) x 100

= (39.4 g ÷ 481.2 g) x 100 = 0.082 x 100

= 8.2 %

STEP 4: DETERMINE THE DRY DENSITY OF THE SOIL

DRY DENSITY = WET DENSITY ÷ [1 + MOISTURE CONTENT (decimal form)]

= 107.4 lb./c.f. ÷ (1 + 0.082)

= 99.3 lb./c.f.

SM 13a(2/74)

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION
PROCTOR COMPACTION TEST

Date 01/02/03
Test By J. LENNON
Check By P.McCARTNEY

Project EARTHWORK INSPECTORS TRAINING Region 1-11 County ANYCOUNTY
Lab. No. _____ Station 0 + 00 Offset 00' RT. Depth _____
Cylinder Data: Wt. 9.12 lbs Height 4.5 in Diameter 4.0 in
Method of Compaction : Wt. of Hammer 5.5 lbs Height of Drop 12 in
STANDARD / MODIFIED Blows per layer 25 Number of layers 3
Top Size Material 3/4 INCH Supplier ABBEY RD. PIT

(START WITH APPROX. 11 LB. (5000 g) -3/4 INCH MATERIAL)

A	Run		1	2	3	4	5	6	7
B	Approximate Moisture %		8	+ 100 ml	+ 100 ml	+ 100 ml	+ 100 ml		
C	Cylinder Volume	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
D	Wt. Cylinder + Wet Soil	lbs	12.70	12.80	12.94	13.17	13.11		
E	Wt. Cylinder	lbs	9.12	9.12	9.12	9.12	9.12	9.12	9.12
F	Wt. Wet Soil (D - E)	lbs	3.58	3.70	3.82	3.95	3.99		
G	Wet Density (F X 30)	lbs/ft³	107.4	111.0	114.6	118.5	119.7		

seepage

H	Tare No.		1	2	3	4	5		
I	Wt. Tare + Wet Soil	g	628.7	641.6	664.2	669.7	661.9		
J	Wt. Tare + Dry Soil	g	**589.3**	**592.9**	**604.5**	**599.5**	**582.5**		
K	Wt. Tare	g	108.1	115.4	111.3	115.6	115.1		
L	Wt. Water (I - J)	g	**39.4**	**48.7**	**59.7**	**70.2**	**79.4**		
M	Wt. Dry Soil (J - K)	g	**481.2**	**477.5**	**493.2**	**483.9**	**467.4**		
N	Moisture Content % (L / M) X 100		***8.2***	***10.2***	***12.1***	***14.5***	***17.0***		
O	Dry Density lbs/ft³ (G / (1+ (N / 100)))		***99.3***	***100.7***	***102.2***	***103.5***	***102.3***		

mixing pan

Remarks :

Seepage occurred in Run 5, second layer

Moisture content sample taken from mixing pan.

LABORATORY COMPACTION

1. **DON'T** hold the compaction hammer off the vertical. Holding the hammer at a slight angle allows the hammer to ride down the inside of the cylinder reducing the compactive effort.

2. **DON'T** raise and drop the compaction hammer with excessive speed or force. This will increase the compactive effort applied.

3. **DON'T** run a compaction test with the mold resting on uneven or soft ground. Compactive effort will be partially absorbed by the ground. A wooden block (10' X10") or hard surface should be used.

DO

1. Select a representative sample for testing.

2. Level and zero all scales before using them.

3. Clean the inside of the hammer. Soil buildup inside the tamper will slow the fall, reducing compactive effort.

4. Clean the bottom of the hammer constantly. A layer of soil on the bottom of the tamper will reduce the compactive effort.

5. Make the layers of soil in the mold as equal as possible.

6. Keep a damp cloth over the mixing pan during the test, to prevent moisture loss.

7. Throughly remix the remainder of the sample after each run, adding water in 2% approximately increments (except in special cases) to establish a good compactive curve.

8. Check the weight of the tamper (5.5 ± 0.02 lbs) and height of drop (12 ± 0.062 inches).

9. Take the moisture content sample from a vertical slice through the center, from all the layers.

10. If seepage is observed at the base or collar of the mold the moisture content sample must be taken from the mixing pan.

FIELD COMPACTION CONTROL

SOIL DENSITY DETERMINATION

FIELD EQUIPMENT

- Volumeter, properly filled with testing sand
- Baseplate matching volumeter
- 2 ½ gallon pail
- Hammer
- Chisel
- Large spoon
- Gallon container w/ friction top
- Safety goggles
- Brush

HOW TO DIG THE HOLE

- Remove loose material from ground surface.
- Level area with baseplate so it is evenly set on surface.
- Begin removing soil through center hole of baseplate :
  - Shade area with your body.
  - Use hammer and chisel to loosen stiff material (remember eye protection).
  - Use spoon to remove soil from hole and put in can (replace lid while digging).
  - Take care to not undercut the baseplate.
  - When hole is about 6" deep and as wide as the baseplate opening, you're done digging.
  - Remove all loose material from inside hole, and on baseplate, and place in can. ***All soil taken from the hole must be put in the can and covered.*** A moisture content test will be run on it.

FIELD COMPACTION CONTROL

SOIL DENSITY DETERMINATION

VOLUME DETERMINATION

- Make sure that construction activities that could create ground vibrations in the vicinity of the test are stopped while you are filling the hole with testing sand.
- With ***valve closed***, invert volumeter and seat in shoulder of baseplate.
- Open valve to allow sand to flow into hole. Do not disturb volumeter until ***sand has stopped flowing***.
- ***Close valve***. Lift volumeter from baseplate.
- Read the three scales on the volumeter to obtain volume of hole. Follow this procedure:
  - Invert volumeter, then return to upright position.
  - Shake volumeter *gently* to level sand surface.
  - Read value from the three scales.
  - Repeat 2X. Average the nine readings. That will be the volume of the hole. The value goes on Line H on Field Compaction Sheet (SM 417b) or Compaction Control Data Sheet (SM 384a).

IF THE LEVEL OF THE SAND IN THE VOLUMETER DOES NOT FALL WITHIN THE RANGE OF THE SCALES, THE TEST IS NO GOOD. YOU MUST RUN ANOTHER TEST.

SM 417 D (5/97)

GEOTECHNICAL ENGINEERING BUREAU
FIELD COMPACTION SHEET
SAND CONE OR VOLUMETER APPARATUS

PROJECT *Earthwork Inspectors School* CONTRACT NO. *D123456*

REGION *1-11* COUNTY *AnyCounty* PIN *1234.56.789*

GRAVITY - BULK SATURATED SURFACE DRY 2.60 TEST BY *M. Mantle*

CHECK BY *R. Maris*

1	Date of Test		GENERAL INFO	01/01/01				
2	Test No.			1				
3	Station of Test			100+0				
4	Offset			CL				
5	Location			Subgrade				
6	Soil Type			Gravel				
A	Weight of Sand & Apparatus (Before)	lbs	HOLE VOLUME					
B	Weight of Sand & Apparatus (After)	lbs						
C	Weight of Sand Used (A - B)	lbs						
D	Apparatus Volume Correction	lbs						
E	Weight of Sand in Hole (Net) (C - D)	lbs						
F	Sand Calibration Factor PCF							
G	Volume of Hole (E ÷ F)	cu ft						
H	Volume of Hole (VOLUMETER)	cu ft		0.071				
J	Weight of Soil & Friction Top Can	lbs	WET DENSITY	11.27				
K	Weight of Friction Top Can	lbs		1.00				
L	Weight of Soil (J - K)	lbs		10.27				
M	Wet Density Field (Total) PCF (L ÷ G) or (L ÷ H)			144.6				
N	Wet Weight +¾" & Tare	lbs		2.77	USE THESE VALUES ON DENSITY CORRECTION CURVE			
P	Weight of Tare	lbs						
Q	Wet Weight +¾" (N - P)	lbs		2.77				
R	% +¾" (Wet) [(Q ÷ L) x 100]			27.00				
S	% -¾" (Wet) (100.0 - R)			73.00				
T	Tare No.		MOISTURE CONTENT	c				
U	Weight Wet Soil & Tare (-¾")	g		661				
V	Weight Dry Soil & Tare (-¾")	g		619				
W	Weight of Tare	g		100				
X	Weight of Water (U - V)	g		42				
Y	Weight of Dry Soil (-¾") (V - W)	g		519				
Z	Moisture Content (-¾") [(X ÷ Y) x 100]			8.1				
AA	Wet Density Field (-¾") PCF (Density Correction Curve)		CONTROL	139				
BB	Dry Density Field (-¾") PCF [AA ÷ (1 + (Z ÷ 100))]			128.6	PLOT THESE VALUES ON COMPACTION CONTROL CURVE			
CC	Weight of Cylinder & -¾"	lbs		12.34				
DD	Weight of Cylinder	lbs		7.91				
EE	Weight of -¾" (CC - DD)	lbs		4.43				
FF	Wet Density -¾" PCF (EE ÷ 1/30) or (EE x 30)			132.9				
GG	Dry Density -¾" PCF [FF ÷ (1 + (Z ÷ 100))]			122.9				
HH	Maximum Dry Density -¾" PCF (Compaction Control Curves)			125.7				
JJ	Optimum Moisture Content % (Compaction Control Curves)			10.5				
KK	% of Maximum Density Obtained [(BB ÷ HH) x 100]			102.3				
LL	Minimum % Density Required			95				
	Pass (KK equal to or greater than LL)							
	Fail (KK less than LL)							

CLASSROOM WORKSHEET VERSION OF SM 384a (4/74)

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
COMPACTION CONTROL SHEET
CLASSROOM WORKSHEET

PIN **1234.56.789**	PROJECT **Earthwork Inspectors School**		
COUNTY **Anycounty**	CONTRACT NO. **D123456**	INSPECTOR **Clouseau**	CHECKED BY **I. Gadget**

DATE OF TEST	01/01/01		01/01/01		01/01/01
TEST NUMBER	1		2		3
STATION OF TEST	100+00		100+50		200+00
OFFSET	40' lt		CL		40' rt
TYPE OF COMPACTOR	Vibratory		Vibratory		Vibratory
NUMBER OF PASSES PER LAYER	6		6		6
SOIL TYPE (SAND; TABLE I) (TILL-SILT-CLAY-GRAVEL; TABLE II)	Gravel		Gravel		Gravel
DEPTH BELOW SUBGRADE SURFACE	15 ft.		15 ft.		15 ft.

1	VOLUME OF HOLE (c.f.) *(FROM VOLUMETER)*	.070		.070		.070
2	WEIGHT OF PLUS 3/4 " (lbs.)	2.0		2.0		2.0
3	WEIGHT OF MINUS 3/4" (lbs.)	7.3		8.0		6.5
4	FIELD WET DENSITY *(FROM CALCULATOR)*	*126*		*138*		*112*
5	WEIGHT OF COMPACTION MOLD (lbs.)	9.0		9.0		9.0
6	WEIGHT OF COMPACTION MOLD & SOIL	13.1		13.2		13.1
7	WEIGHT OF SOIL *(LINE 6 MINUS LINE 5)*	4.1		4.2		4.1
8	REQUIRED DENSITY *(% OF MAX. DRY)*	95		95		95
	GO TO COMPACTION CONTROL TABLES FOR LINES 9, 10, & 11					
9	COMPACTION CONTROL TABLE NUMBER	II		II		II
10	*HIGHEST* FIELD WET DENSITY REQUIRED	*128*		*127**		*126**
11	*LOWEST* FIELD WET DENSITY ALLOWED	*117*		*120*		*117*
12	PASS *(LINE 4 EQUAL TO OR GREATER THAN LINE 10)*			✓		
13	FAIL *(LINE 4 IS LESS THAN LINE 11)*					✓
14	RUN MOISTURE CONTENT TEST *(500g SAMPLE)*	✓				
	MOISTURE CONTENT DETERMINATION					
15	WEIGHT OF DRY SOIL AND TARE *(grams)*	672				
16	% MOISTURE CONTENT *(FROM M. C. TABLE)*	6				
17	*FIELD WET DENSITY REQUIRED (FROM TABLES)*	*126*				
18	*PASS (LINE 4 EQUAL TO OR GREATER THAN LINE 17)*	✓				
19	*FAIL (LINE 4 IS LESS THAN LINE 17)*					
20	*APPROX. % MAX. DENSITY (OPTIONAL)*	*95*				

REMARKS * *Regional Geotechnical Engineer determines the minimum moisture content allowed*

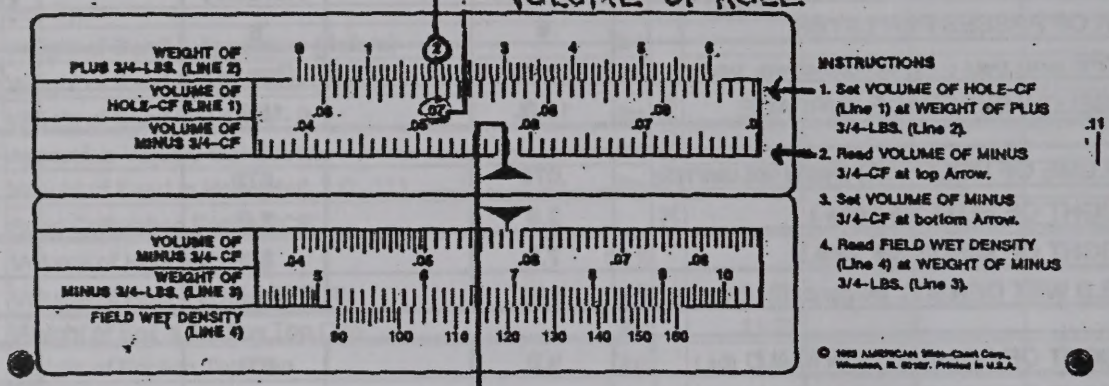
GIVEN

- VOLUME OF HOLE = .070 cf. (DIRECT READ OFF VOLUMETER)
- WEIGHT OF +3/4" = 2.0 lbs.
- WEIGHT OF -3/4" = 7.3 lbs.

FIELD WET DENSITY CALCULATOR

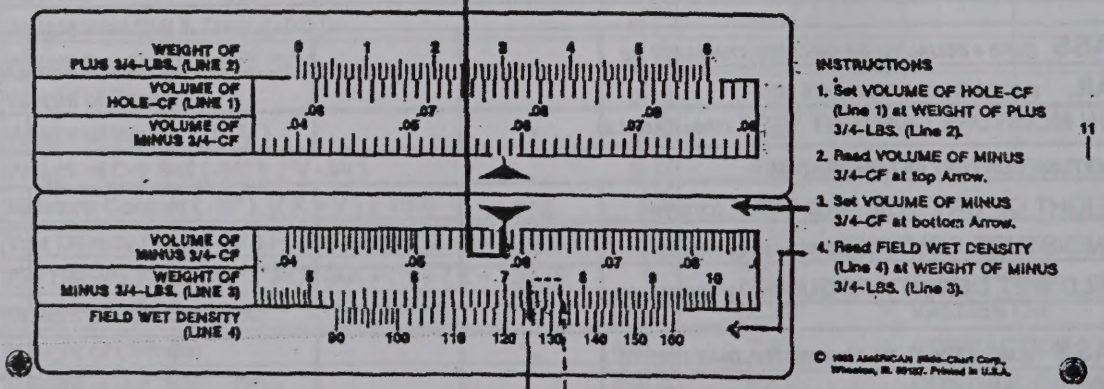
WT. OF +3/4" MATERIAL

VOLUME OF HOLE



VOLUME -3/4"
= .058 cf

FIELD WET DENSITY CALCULATOR



→ WT. OF -3/4" MATERIAL (7.3 lbs GIVEN)

→ FIELD WET DENSITY

∴ = 126 lbs/ft³

RECORD ON LINE 4 OF DATA SHEET

FIELD DENSITY CONTROL

1. **DON'T** take for granted that scales are in proper operating condition. Check their condition carefully.

2. **DON'T** assume that the weights of tares and friction top cans are constant, weigh each before testing.

3. **DON'T** wait until the test hole has been completed to place soil retained on the base plate into the friction top can. This will result in moisture loss.

4. **DON'T** shut off the valve on the volummeter before the sand has stopped flowing.

DO

1. Level and zero all scales prior to use.

2. Check the weight of tares and friction top cans prior to use.

3. Completely empty and then refill the volumeter for each test.

4. Make sure the test area for the base plate is level and seated properly on the surface.

5. Keep the cover on the friction top can while digging the hole, to prevent moisture loss.

6. Ensure all material from the hole is placed in the can. This includes soil on the tools and any loose material from the bottom of the hole.

7. Keep traffic and heavy equipment away from the test area while the sand is flowing. Vibration will compact the sand in the hole, resulting in a larger hole volume and a lower density.)

8. Visually identify the soil to determine which family of Control Curves (STM-9) or Compaction Control Table (STM-6) are to be used to determine the percentage of the maximum density.

ALL THE PREVIOUS NOTES ON LABORATORY COMPACTION STILL APPLY.